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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/762,013	01/21/2004	Michihisa Maeda	42P9978C	4494

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EXAMINER

NOVACEK, CHRISTY L


ART UNIT

PAPER NUMBER

2822

DATE MAILED: 11/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/762,013	Applicant(s) MAEDA ET AL. 	
	Examiner Christy L. Novacek	Art Unit 2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 October 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-13 and 26-31 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-13 and 26-31 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>1/21/04 & 3/12/05</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This office action is in response to the Election and amendment filed October 17, 2005.

Election/Restrictions

Applicant's election of the invention of Group I, claims 1-13 and 26-31 in the paper filed October 17, 2005 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Non-elected claims 14-25 and 32-39 have been canceled.

Specification

The disclosure is objected to because of the following informalities: The first sentence of the first page of the specification should be amended to include the patent number of the parent application.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 26-31 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 26 recites a broad limitation and then a narrow limitation within the broad limitation. A broad range or limitation together with a narrow range or limitation that falls within

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the broad range or limitation (in the same claim) is considered indefinite, since the resulting claim does not clearly set forth the metes and bounds of the patent protection desired. Note the explanation given by the Board of Patent Appeals and Interferences in *Ex parte Wu*, 10 USPQ2d 2031, 2033 (Bd. Pat. App. & Inter. 1989), as to where broad language is followed by "such as" and then narrow language. The Board stated that this can render a claim indefinite by raising a question or doubt as to whether the feature introduced by such language is (a) merely exemplary of the remainder of the claim, and therefore not required, or (b) a required feature of the claims. Note also, for example, the decisions of *Ex parte Steigewald*, 131 USPQ 74 (Bd. App. 1961); *Ex parte Hall*, 83 USPQ 38 (Bd. App. 1948); and *Ex parte Hasche*, 86 USPQ 481 (Bd. App. 1949). In the present instance, claim 26 (line 6) recites the broad recitation "applying a first plurality of solder bumps or a first plurality of metal bumps", and the claim (line 16) also recites "bringing the first plurality of solder bumps into contact" which is the narrower statement of the range/limitation. Additionally, claim 26 (line 8) recites the broad recitation "applying a second plurality of solder bumps or a second plurality of metal bumps", and the claim (lines 16-17) also recites "the second plurality of metal bumps" which is the narrower statement of the range/limitation.

In addition, the limitations of "the no-clean flux substantially consisting of components having volatilization temperatures below a melting temperature" in lines 12-14 of claim 26 and "heating the first plurality of solder bumps to a first temperature in excess of the melting temperature" in lines 18-19 of claim 26 are indefinite because the claim needs to recite "a melting temperature" of a particular material.

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Claim 27 recites the limitation of “the first plurality of metal bumps” and “the second plurality of solder bumps”. However, claim 26, upon which claim 27 depends recites, “the first plurality of solder bumps” and “the second plurality of metal bumps”.

Claims 28 and 31 recite the limitation of “the second plurality of solder bumps”. However, claim 26, upon which claims 28 and 31 depend recites, “the second plurality of metal bumps”.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art in view of Yagi et al. (US 6,109,507, cited in IDS).

Regarding claim 1, Applicant's own admitted prior art discloses applying a flux to a first surface of a substrate having solder bumps attached thereto. The solder bumps are aligned and brought into contact with corresponding metal bumps that are attached to a first surface of a chip. The solder bumps are heated to a first temperature that is equal or greater to the melting temperature of the solder bumps. The admitted prior art discloses using a flux which does not have a volatilization temperature less than the melting temperature (paragraphs 0004-0006). Like the admitted prior art, Yagi discloses a process of applying solder and flux to a substrate and using heat to attach the solder to the substrate. Yagi discloses that it is advantageous for the

flux to have a volatilization temperature less than the melting point of the solder because that way, voids in the solder ball caused by trapped air bubbles can be prevented (col. 13, ln. 24-31). At the time of the invention, it would have been obvious to one of ordinary skill in the art to substitute the flux of Yagi in the invention of the admitted prior art because Yagi's flux leaves behind no undesirable voids in the solder balls, thus improving the reliability of the bond between the chip and the substrate.

Claims 2, 5 and 26-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art in view of Yagi et al. (US 6,109,507) as applied to claim 1 above, and further in view of Hur et al. (US 6,013,572, cited in IDS).

Regarding claim 2, Applicant's admitted prior art does not disclose the materials that make up the first surface of the chip. Like the admitted prior art, Hur discloses a method of bonding a chip to a substrate using solder bumps. Hur teaches that a chip surface having bonding pads including copper can provide strong adhesiveness to the chip and is strong enough to withstand damage during subsequent processing (col. 3, ln. 60 – col. 4, ln. 14; col. 6, ln. 56-67). Hur also teaches that methods of manufacturing this type of bonding pad is well-known in the art (col. 4, ln. 12-14). At the time of the invention, it would have been obvious to one of ordinary skill in the art to form the bonding pads on the surface of the chip of the admitted prior art such that they are the copper-containing bonding pads of Hur because the admitted prior art does not disclose any particular bond pad material and Hur teaches that a bond pad including copper has strong adhesiveness and increased durability.

Regarding claim 5, Applicant's admitted prior art discloses that conventional solder is made of 97% Pb and 3% Sn. Like the admitted prior art, Hur discloses a method of bonding a

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chip to a substrate using solder bumps. Hur teaches a method whereby the solder bumps are comprised of 96.5% Sn and 3.5% Ag (col. 7, ln. 42-43). Hur states that the Sn/Ag solder bumps are advantageous over the conventional Pb/Sn solder bumps because lead is harmful to the environment (col. 1, ln. 35-47). At the time of the invention, it would have been obvious to one of ordinary skill in the art to replace the Pb/Sn solder balls of the admitted prior art with the Sn/Ag solder balls disclosed by Hur because Hur teaches that it is advantageous to use Sn/Ag solder balls instead of Pb/Sn solder balls because lead is harmful to the environment.

Regarding claims 26 and 27, Applicant's own admitted prior art discloses applying a flux to an active surface of a substrate having a plurality of solder bumps attached thereto. The solder bumps are aligned and brought into contact with corresponding metal bumps that are attached to a first surface of a chip. The solder bumps are heated to a first temperature that is equal or greater to the melting temperature of the solder bumps. The admitted prior art discloses using a flux which does not have a volatilization temperature less than the melting temperature (paragraphs 0004-0006). Like the admitted prior art, Yagi discloses a process of applying solder and flux to a substrate and using heat to attach the solder to the substrate. Yagi discloses that it is advantageous for the flux to have a volatilization temperature less than the melting point of the solder because that way, voids in the solder ball caused by trapped air bubbles can be prevented (col. 13, ln. 24-31). At the time of the invention, it would have been obvious to one of ordinary skill in the art to substitute the flux of Yagi in the invention of the admitted prior art because Yagi's flux leaves behind no undesirable voids in the solder balls, thus improving the reliability of the bond between the chip and the substrate. Applicant's admitted prior art does not disclose forming a plurality of metal bumps on the active surface of the chip. Yagi discloses that when

attaching a circuit board to a chip, the solder bumps on the circuit board are aligned to electrodes on the active surface of the chip and the solder bumps are reflowed, thus attaching the solder bumps to the electrodes. In order for the semiconductor chip to be functional, the electrode must be conductive. Yagi does not specifically teach that the electrodes are made of metal. Hur teaches that the bonding pads (UBM) of the chip are preferably made by layering several metals. Hur teaches that a chip surface having the bonding pads including several layers of metal can provide strong adhesiveness to the chip and is strong enough to withstand damage during subsequent processing (col. 3, ln. 60 – col. 4, ln. 14; col. 6, ln. 56-67). Hur also teaches that methods of manufacturing this type of bonding pad is well-known in the art (col. 4, ln. 12-14). At the time of the invention, it would have been obvious to one of ordinary skill in the art to form the bonding pads on the surface of the chip of the admitted prior art such that they are the copper-containing bonding pads of Hur because the admitted prior art does not disclose any particular bond pad material and Hur teaches that a bond pad including copper has strong adhesiveness and increased durability.

Regarding claim 28, Yagi teaches that both the chip pads and the substrate pads can have solder bumps formed thereon, and then the solder bumps are bonded together (Fig. 14; col. 11, ln. 23-34). At the time of the invention, it would have been obvious to one of ordinary skill in the art to form solder balls on both the chip pads and the substrate pads, depending upon the shape and size of the chip and circuit board because, by doing so, neither the method, nor the final product would be changed.

Regarding claim 29, at the time of the invention, it would have been obvious to one of ordinary skill in the art to reverse the initial positions of the solder bumps and metal bumps,

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depending upon the shape and size of the chip and circuit board because, by doing so, neither the method, nor the final product would be changed.

Regarding claims 30 and 31, the admitted prior art, Yagi and Hur do not disclose the heating rate applied to the solder bumps. At the time of the invention, it would have been obvious to one of ordinary skill in the art to use routine experimentation to determine an optimal heating rate of the substrate, depending upon the types of solder and flux being used because such variables of art recognized importance are subject to routine experimentation and discovery of an optimum value for such variables is obvious. See *In re Aller*, 105 USPQ 233 (CCPA 1955).

Claims 3, 4 and 7-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art in view of Yagi et al. (US 6,109,507) as applied to claim 1 above, and further in view of Kimura et al. (US 6,400,034, cited in IDS).

Regarding claims 3, 4 and 7-13, Applicant's admitted prior art does not disclose a method for heating the solder bumps and joining the chip to the substrate. Like the admitted prior art, Kimura discloses a process of flip-chip bonding a substrate to a chip wherein metal contacting the chip and substrate is used to bond the chip and substrate together. Kimura teaches using a thermo-compression bonding tool to effect the flip-chip bonding. By this method, the substrate is attached to a lower platen that is maintained at a temperature of 70°C, the chip is attached to a heater which applies both heat (at a temperature of 300°C) and a pressure (at a force of 75-125 gf/bump) to a second surface of the chip whereby the heat is conducted through the chip such that the metal becomes bonded to both the chip and the substrate. The heat and pressure are applied to the chip for a time period of 2.5-7.5 seconds to conduct the bonding and then the

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contact force is removed (col. 6, ln. 64 – col. 7, ln. 35). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the thermo-compression bonding method of Kimura to effect the bonding of the chip to the substrate of the admitted prior art because the Kimura teaches that using his particular thermo-compression process, a chip can be bonded to a substrate with reduced heat and pressure application.

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art in view of Yagi et al. (US 6,109,507) as applied to claim 1 above, and further in view of Arbib (EP 0077622).

Regarding claim 6, Yagi discloses that it is beneficial to use a flux that has a lower boiling point than the melting point of the solder, but Yagi does not disclose any particular flux. Like Yagi, Arbib discloses using a flux to assist in the bonding of electronic components and also teaches that the flux should have a lower boiling point than the soldering temperature. Arbib discloses that this type of flux preferably comprises a flux material having at least one carboxylic acid group (Abstract). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the flux of Arbib to do the solder bonding disclosed in the admitted prior art because both Yagi and Arbib teach using a flux that has boiling point below the soldering temperature and Arbib discloses that this type of flux can successfully be made using a flux material having at least one carboxylic acid group. It would also have been obvious to one of ordinary skill in the art to use routine experimentation to determine an optimal boiling point of the flux, depending upon the type of solder being used because such variables of art recognized importance are subject to routine experimentation and discovery of an optimum value for such variables is obvious. See *In re Aller*, 105 USPQ 233 (CCPA 1955).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christy L. Novacek whose telephone number is (571) 272-1839. The examiner can normally be reached on Monday-Thursday and alternate Fridays 7:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

CLN
November 9, 2005



Michael Trinh
Primary Examiner